Teachers' Perception on Technology Use in Teaching Mathematics in Rwandan Day Secondary Schools

Delphine Nzayisenga, Onesme Niyibizi & Alphonse Uworwabayeho

African Centre of Excellence for Innovative Teaching and Learning Mathematics and Science, University of Rwanda, College of Education

Email: nzdelphine@yahoo.com

Abstract: This study explored the perceptions of teachers regarding the integration of technology in the teaching of mathematics within Rwandan day secondary schools. This research aimed to shed light on how Rwandan educators perceive and utilize technology in the context of teaching mathematics. The population for this investigation consisted of 61 teachers of mathematics and a total of 51 teachers were targeted for the survey, and a subset of 26 teachers were being selected for in-depth interviews. The study employed a mixed-methods approach, combining surveys and interviews, to gather data from mathematics teachers in Rwandan day secondary schools. The quantitative phase involved the distribution of questionnaires to a representative sample of educators, while the qualitative phase comprised in-depth interviews with select participants. These methods aimed to provide a comprehensive understanding of teachers' perceptions, experiences, and challenges related to the integration of technology in their mathematics instruction. The findings of this research suggested that Rwandan mathematics teachers generally hold positive perceptions regarding the integration of technology into their classrooms. They perceived technology as a valuable tool for enhancing mathematics instruction by making it more engaging, interactive, and conducive to student-centered learning. Additionally, teachers believe that technology can help bridge the gap between theoretical concepts and real-world applications. However, the study also indicated several challenges faced by mathematics teachers when incorporating technology into their teaching practices. Moreover, the research highlights the need for sustainable policies and investments in educational technology infrastructure and teacher training to maximize the benefits of technology integration.

Keywords: Educational Technology in Rwanda, Rwandan Day Secondary Schools, Teacher Perception on Technology in Education, Technology Adoption in Rwandan Schools, Technology Integration in Mathematics Education.

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1. Introduction

In the ever-evolving landscape of education, the integration of technology has emerged as a transformative force, reshaping pedagogical approaches and classroom dynamics worldwide. This paradigm shift is particularly pertinent in the context of mathematics education, where the fusion of technology and traditional teaching methods has the potential to revolutionize the way students learn and engage with mathematical concepts. In the heart of East Africa, Rwanda stands as a nation committed to the advancement of its education system, striving to equip its youth with the skills and knowledge needed to navigate the challenges of the 21st century. At the forefront of this educational transformation are the teachers in Rwandan day secondary schools, who play a pivotal role in shaping

students' perceptions and understanding of mathematics. This study investigated the fascinating realm of teachers' perceptions regarding the use of technology in teaching mathematics within Rwandan day secondary schools. It seeks to unravel the intricate tapestry of beliefs, attitudes, and experiences that inform how educators harness digital tools and resources to enhance the learning experience. The integration of technology in mathematics instruction has the potential to bridge gaps in understanding, facilitate interactive learning, and promote critical thinking skills. Yet, it also poses challenges in terms of access, training, and pedagogical adaptation. Therefore, understanding the perceptions of teachers is crucial to gain insights into the opportunities and obstacles associated with this transformative journey.

Rwanda's commitment to fostering a knowledge-based society aligns with its ambitious educational agenda, as reflected in its policies and initiatives aimed at harnessing the power of technology to improve learning outcomes. To achieve this vision, it is essential to listen to the voices of the educators who are at the forefront of this change. Their experiences, insights, and challenges can illuminate the path toward a more effective and dynamic mathematics education in Rwandan day secondary schools. This research embarked on a journey to explore the multifaceted world of teachers' perceptions on technology use in teaching mathematics in Rwanda. By delving into their perspectives, researchers hope to not only understand the current state of technology integration but also contribute to the ongoing dialogue about how to shape the future of mathematics education in this vibrant East African nation. Through this exploration, researchers aimed to shed light on the evolving role of technology in Rwandan classrooms and, ultimately, the broader educational landscape. Through a synthesis of teachers' viewpoints, researchers explored the multifaceted factors that influence their perception of technology use in mathematics instruction. Moreover, researchers explored the challenges they encountered, the strategies they employ, and the potential benefits they envision in this endeavor. Ultimately, this research seeks to contribute to the ongoing dialogue on educational technology adoption, offering insights that can inform policy decisions and pedagogical approaches to enhance mathematics education in Rwandan day secondary schools.

2. Literature Review

A literature review is a critical component of the research process that provides a comprehensive overview of existing scholarship related to a specific topic. In the context of this study, the literature review serves as the foundation for understanding the current state of knowledge and research on the subject. It not only offers insights into the historical development of technology in education but also highlights the perceptions and experiences of teachers in using technology to teach mathematics, particularly in the context of Rwandan day secondary schools. This literature review explored key themes, trends, and findings in the field, shedding light on the challenges, opportunities, and best practices associated with the integration of technology in mathematics education in Rwanda. By synthesizing this existing knowledge, the research intentions to build upon and contribute to the ongoing discourse surrounding technology's role in enhancing mathematics instruction.

2.1. The use of technology in teaching Mathematics

Technology has become an integral part of modern education, offering innovative ways to enhance teaching and learning experiences. In the context of Rwandan day secondary schools, the integration of technology into mathematics instruction has gained attention. This literature review intended to analyze teachers' perceptions of technology use in teaching mathematics in Rwandan day secondary schools. ICT is changing processes of Mathematics teaching and learning by bringing life to classroom educational settings, together with digital ones created specifically for the objective. The modern ICT utilizes the variety of various technologies; like software, hardware, delivery systems, and multimedia. ICT in education today refers to a wide variety of instruments that are rapidly advancing technology; such as Computers, Smartboards, Handheld Calculators, Overhead projector, Smartphones, DVDs, Personal digital assistant, Internet, Digital Cameras Cloud Computing, and Mobile phones; and applications such as Simulator, Spread sheet, Virtual Environment, Word processors, Digital libraries, Emulator, Video conferencing, Computer-Mediated Conferencing (Das, 2019; Alazam, Bakar, & Asmiran, 2008; Abbas, 2013; Buabeng-Andoh, 2012; Dube, Nhamo, & Magonde, 2018; Jatileni & Jatileni, 2018; Volman, Eck, Heemskerk, & Kuiper, 2005; Niyibizi, Uwitatse, Sibomana, & Mutarutinya, 2023). Technology plays a significant role in bringing innovation to teaching practices, and its effective integrations helps students meet their learning needs (Niyibizi, Uwitatse, Sibomana, & Mutarutinya, 2023). Their study indicated that technology is the frequently developing result of accumulated knowledge and application in all procedures, techniques, skills and processes employed in industrial production and academic study.

2.2. Teachers' practices regarding to the technology

Technology integration in education has become a global trend, with a growing emphasis on its potential to enhance teaching and learning outcomes in various subjects, including mathematics. Rwanda, as a developing country, has been actively investing in its educational infrastructure, including the integration of technology in classrooms. Understanding teachers' perspectives is crucial for effective technology adoption

in the Rwandan education system. According to Abbas (2013), teachers' perceptions of their own computer skills play a significant factor in how well they use ICT in the classroom. Their findings indicated that the school environment includes elements like the kind of school board, the language spoken, the facilities for the teachers' training programs, and the kinds of subjects that are taught by the teachers. According to Buabeng-Andoh (2012) had embraced this categorization and examine the impact of teachers' personal characteristics on the effective use of ICT and stated that individual factors; including a teacher's gender, age, educational background, and teaching experience are crucial to the efficient use of ICT in the classroom. The perspectives of teachers offer an explanation for their beliefs regarding the benefits of integrating ICT into teaching and learning. Teachers' views on ICT use can be regarded as how they perceive, understand, and interpret the use of technology in teaching and learning. Information communications technology (ICT) use has been shown to have some good benefits on students' learning globally (Galligan, Loch, McDonald, & Taylor, 2010; Gebremedhin & Fenta, 2015; Ghavifekr, Kunjappan, Ramasamy, & Anthony, 2016; Niyibizi, Uwitatse, Sibomana, & Mutarutinya, 2023) their findings indicated that numerous training programs, school investments in ICT resources, and the adoption of ICT in schools had been terribly slow (Buabeng-Andoh, 2012). In addition, ICT and particularly computer-assisted learning (CAL) recently has become a more significant component of lesson activities in the classroom. Thus, Teachers must also learn ICT skills and conversant with the ICT resources that are at their disposal.

Recent studies have demonstrated that teachers' opinions affect how technology is used in their classrooms, and that teachers who have favorable views of technology use in general and computer use in their classes are more likely to do so (Bingimlas, 2009; Buabeng-Andoh, 2012). In many cases, the teachers with technophobic behavior mostly employ traditional teaching techniques and refrain from making use of computers, whereas they possess ICT-resources. In accordance with the general assumption and the E-education policy of the education department, the use of ICT resources will create a platform for CAL that will give teachers and students a wide range of fascinating chances for establishing multiple levels of interactivity (Gebremedhin & Fenta, 2015) the teachers' own ideas and concerns about using technology influence their willingness to do so, and one of the challenges affecting the use of ICT in education is the instructors' negative perceptions of it. Therefore, it is clear that teachers' perspectives about their roles in education will affect how they use technology to teach (Kreijns, Vermeulen, Acker, & Buuren, 2013) the positive attitudes of instructors toward incorporating ICT into the teaching-learning process are what motivate the use of ICT in classrooms., which in turn stimulates students' creative thought and pedagogical content understanding (Jatileni & Jatileni, 2018). ICT should be

the driving force behind lessons, but they should also be focused on specific teaching and learning goals, with ICT serving as a means of achieving those goals. Because of this, teachers frequently choose to employ ICT depending on their prior experience, perceived level of competence, and proficiency with a particular ICT device (Jatileni & Jatileni, 2018).

Understanding teachers' perceptions of technology use in teaching mathematics in Rwandan day secondary schools is crucial for effective integration and improving educational outcomes. This literature review has highlighted the potential benefits of technology, teachers' attitudes, challenges, training programs, student outcomes, and contextual factors as essential aspects to consider in this context. The research was guided by this research question: How do Rwandan day secondary school teachers perceive the use of technology in teaching mathematics, and what factors influence their practices regarding technology integration in the classroom?

2.3. Theoretical framework

Technology Acceptance Model (TAM): The Technology Acceptance Model is a well-established theory that explores how users, in this case, teachers, perceive and adopt new technology in their classroom. It posits that a teacher's intention to use technology in teaching mathematics is influenced by two main factors. Perceived Usefulness: According to TAM, teachers are more likely to embrace technology in their mathematics instruction if they perceive it as useful. In the context of Rwandan day secondary schools, technology should be seen as a tool that enhances the quality of mathematics education. For example, teachers may believe that technology can help students better visualize complex mathematical concepts or provide access to a wider range of educational resources. Perceived Ease of Use: The second factor in TAM is the perceived ease of use. Teachers are more inclined to adopt technology if they believe it is easy to integrate into their teaching methods. In Rwandan day secondary schools, factors such as the availability of training and support, the compatibility of technology with existing curricula, and the teacher's technological competence play a crucial role in determining their perception of ease of use. Applying TAM to the Rwandan context, researchers investigated how these factors influence teachers' perceptions of technology use in mathematics education and what strategies can be employed to enhance these perceptions.

Diffusion of Innovations Theory: The Diffusion of Innovations theory focuses on how innovations are adopted and spread within a social system. In the context of teachers' perceptions of technology use in teaching mathematics, this theory was applied as follows. Innovators, according to this theory, teachers can be categorized into different groups based on their willingness to adopt technology in mathematics

education. Innovators are the first to embrace new technology. In Rwandan day secondary schools, researchers investigated the characteristics and motivations of teachers in each of these categories. Understanding the factors that differentiate these groups can inform strategies for promoting technology adoption. Communication Channels and Social Systems, the diffusion of innovations is influenced by communication channels and social networks. Teachers in Rwandan schools may be influenced by their peers, administrators, or external experts when it comes to adopting technology. Researchers examined how information about technology spreads within schools and how social dynamics affect teachers' perceptions and decisions regarding its use. By applying these two theories, researchers gained valuable insights into teachers' perceptions of technology use in teaching mathematics in Rwandan day secondary schools. This knowledge pointed at promoting the effective integration of technology into mathematics education in the Rwandan context.

3. Methodology

The methodology of this study serves as the blueprint for the research process, detailing the systematic approach and techniques employed to investigate the perceptions of teachers regarding the integration of technology into mathematics instruction in Rwandan day secondary schools. This section outlines the research design, data collection methods, data analysis procedures, and ethical considerations that guided the study's execution and ensure the reliability and validity of its findings. By employing a well-structured methodology, this research ambitions to shed light on the complex relationship between educators, technology, and mathematics education in the Rwandan context, ultimately contributing to the enhancement of pedagogical practices in the country's secondary schools.

3.1. Research approach

In today's rapidly evolving educational landscape, the integration of technology in teaching has emerged as a transformative force, offering new avenues for engaging and enhancing the learning experience of students. The role of technology in teaching mathematics, in particular, has gained increasing attention worldwide as educators seek innovative methods to improve the quality of education. Rwanda, a nation committed to the advancement of its education system, has not remained untouched by this global trend. This study is positioned at the intersection of technology and mathematics education within the context of Rwandan secondary schools. The introduction of technology into the classroom is not without its complexities. It raises questions about how teachers perceive and utilize technology in their teaching practices. Understanding these perceptions is crucial for the successful integration of technology into the teaching of mathematics. Therefore, this research seeks to investigate the

perceptions of mathematics teachers in Rwandan day secondary schools regarding the use of technology in their instructional methods. This study recognizes that the effective implementation of technology in teaching mathematics demands an insightful understanding of the attitudes, beliefs, and challenges faced by teachers. The insights gained from this research are expected to inform educational policymakers, school administrators, and curriculum developers in Rwanda about the current state of technology integration in mathematics education and the barriers that may be hindering its effective utilization.

To achieve this, the research employed a comprehensive approach, utilizing both qualitative and quantitative methods to collect data, ensuring a well-rounded exploration of the teachers' perceptions. This mixed-methods approach enabled to delve deeper into the nuances of technology adoption in mathematics teaching within the Rwandan context. As technology continues to reshape education worldwide, this study ambitions to contribute to the ongoing discourse surrounding technology integration by offering valuable insights into the specific challenges and opportunities experienced by mathematics teachers in Rwandan day secondary schools. Ultimately, the findings of this research may serve as a catalyst for the development of strategies and policies that promote the effective use of technology in mathematics education, ultimately benefiting students and helping Rwanda achieve its educational goals in a technology-driven world. This current study adopted a mixed-methods research approach, combining both quantitative and qualitative methods to provide a comprehensive understanding of teachers' perceptions regarding technology use in teaching mathematics.

3.2. Research setting

The integration of technology into educational settings has become a global phenomenon with the potential to transform the teaching and learning process. In this context, the study delves into the specific landscape of Rwandan day secondary schools to investigate the attitudes and perspectives of educators regarding the use of technology in teaching mathematics. Rwanda, a nation in East Africa, has been steadfast in its commitment to improving its educational infrastructure and outcomes, and the inclusion of technology in classrooms aligns with this overarching goal. In recent years, the Rwandan government has shown a clear dedication to advancing technology in education, and as a result, there has been a proliferation of digital tools and resources within the country's schools. This has profound implications for the teaching of subjects like mathematics, a discipline that often benefits from interactive, dynamic, and multimedia-based approaches. Understanding how teachers in Rwandan day secondary schools perceive and engage with technology in the context of mathematics education is crucial for multiple reasons. First, it sheds light on the effectiveness of the government's investment in educational technology and the extent to which it has

been integrated into the curriculum. Secondly, it provides insight into the challenges and opportunities encountered by teachers as they adapt to this new teaching paradigm. Finally, it helps identify the potential impact of technology on students' learning experiences and outcomes, ultimately contributing to the broader conversation about the enhancement of mathematics education in Rwanda.

This research study intentions to explore the current landscape in Rwandan day secondary schools, capturing the diverse perspectives and experiences of teachers who are on the frontlines of this educational transformation. By gaining an in-depth understanding of teachers' perceptions, attitudes, and experiences regarding the use of technology in teaching mathematics, this study provided valuable insights that can inform educational policies and practices, ultimately contributing to the ongoing evolution of mathematics education in Rwanda. The research was conducted in Rwandan day secondary schools in Rulindo District, targeting mathematics teachers. The selection of day schools ensures that the study focuses on the regular school environment, where technology integration is essential for educational success. At the present time of this study, the research population for this investigation consisted of 61 teachers of mathematics from 23 day secondary schools in Rulindo District.

3.3. Research participants

The use of technology in education has become an integral part of modern pedagogy, offering innovative tools and resources that can enhance the teaching and learning process. In the context of Rwandan day secondary schools, where mathematics education plays a crucial role in shaping students' academic and professional futures, understanding how teachers perceive and utilize technology in the teaching of mathematics is of paramount importance. This study explores the perspectives of teachers in Rwandan day secondary schools regarding the integration of technology into their mathematics classrooms. Teachers are key stakeholders in the educational landscape, as they directly impact the quality of instruction and the learning experiences of students. Their perceptions, attitudes, and practices regarding the incorporation of technology can significantly influence the effectiveness of mathematics instruction. This research focuses on gaining insights into the attitudes, beliefs, challenges, and opportunities perceived by teachers in Rwandan day secondary schools when using technology to teach mathematics. The utilization of technology in mathematics instruction can encompass various aspects, such as interactive digital tools, e-learning platforms, software applications, and digital resources. This study targets to provide a comprehensive understanding of how teachers in Rwandan day secondary schools adapt and integrate these technological resources into their teaching methodologies.

By exploring the teachers' perspectives, this research seeks to identify the existing barriers and facilitators to technology adoption in mathematics classrooms. Furthermore, it intends to shed light on the potential benefits that technology can offer in the teaching of mathematics and how these advantages align with the broader goals of the Rwandan education system. Ultimately, the findings of this study contribute to the ongoing discourse on the role of technology in Rwandan day secondary schools, helping educators, policymakers, and educational institutions better understand how to harness technology to improve the teaching and learning of mathematics. It also informs the development of strategies and policies that support teachers in effectively integrating technology into their instructional practices, ultimately enhancing the quality of mathematics education in Rwanda. The research involved teachers from a purposive sample of Rwandan day secondary schools, participants were selected based on their experience in teaching mathematics and their willingness to participate in the study. A total of 51 teachers were targeted for the survey, and a subset of 26 teachers were being selected for in-depth interviews. According Krejcie and Morgan table, the sample included 51 mathematics teachers who are permanent employees in selected day schools of Rulindo district.

3.4. Sampling techniques and sample size

In the field of educational research, understanding teachers' perceptions and practices regarding the integration of technology in the classroom is of paramount importance, as it directly impacts the quality of education. In the context of Rwandan day secondary schools, where the use of technology in teaching mathematics is an emerging and dynamic area, conducting a comprehensive study on teachers' perceptions becomes crucial. However, gathering data from an entire population of teachers may be impractical due to resource constraints and time limitations. Therefore, this study employs specific sampling techniques to systematically select a subset of teachers from the larger population, allowing for a representative and manageable sample to be examined in-depth. Sampling techniques play a pivotal role in research design by providing a structured framework for selecting participants or data points from a broader population. These techniques ensure that the sample is not only representative of the population but also minimizes bias and enhances the generalizability of the study's findings. In the context of this study, the application of appropriate sampling techniques is essential to gain insights into the prevailing trends and challenges associated with technology integration in mathematics education. By implementing sound sampling techniques, the study intends to gather data from a carefully selected group of teachers, whose experiences and opinions will serve as valuable indicators of the broader teaching community's attitudes towards technology adoption.

This approach is not only to ensure the research's practicality but also promote the credibility and validity of the findings. The choice of sampling techniques in this study is guided by the need to strike a balance between the representative nature of the sample and the practical constraints of data collection in Rwandan day secondary schools. The study's research design, informed by these sampling techniques, provide a solid foundation for assessing teachers' perceptions, attitudes, and challenges related to the integration of technology in mathematics education. Ultimately, this research can contribute to the improvement of technology integration strategies and policies in Rwandan day secondary schools, thereby enhancing the quality of mathematics instruction in the region. A stratified random sampling technique employed to ensure representation from different regions and types of day secondary schools in Rwanda of Rulindo District. Stratification was based on school location (rural) and school ownership (public). From each stratum, a random sample of mathematics teachers were selected. The sample size for the survey expected to include a minimum of 51 mathematics teachers, while the qualitative interviews involved 26 participants.

3.5. Data collection method

In the ever-evolving landscape of education, the integration of technology has become an integral component of teaching and learning. In the context of Rwandan day secondary schools, where mathematics education plays a crucial role in shaping students' cognitive development, understanding how teachers perceive and utilize technology in their mathematics instruction is of paramount importance. This study explores into the intricate fabric of teaching mathematics by investigating the perceptions of teachers regarding technology use in their classrooms. To achieve this objective, the research employs a comprehensive data collection method that combines various techniques, providing a holistic view of the teachers' perspectives. The process of collecting data for this study is multifaceted, designed to capture the richness and diversity of experiences and opinions among Rwandan day secondary school teachers. The research incorporates both quantitative and qualitative data collection methods to ensure a well-rounded understanding of the phenomenon under investigation. Quantitative data gathered through structured questionnaires distributed to a representative sample of mathematics teachers in Rwandan day secondary schools. These questionnaires were designed to elicit information about the extent of technology integration, the types of technology used, the frequency of use, and the perceived benefits and challenges associated with technology in teaching mathematics. The use of surveys allows for the collection of standardized, quantifiable data that can be subjected to statistical analysis, enabling the identification of trends and patterns. In addition to quantitative data, this study also adopts qualitative data collection methods to explore the nuanced perspectives of teachers. Semi-structured

interviews conducted with a subset of participants to delve deeper into their perceptions, experiences, and challenges related to technology use in teaching mathematics. These interviews provide a platform for teachers to express their thoughts, feelings, and beliefs, which may not be easily quantifiable but are nonetheless invaluable in understanding the complexities of technology integration in mathematics education.

By employing a combination of quantitative and qualitative data collection methods, this study seeks to offer a comprehensive analysis of teachers' perceptions and practices concerning technology use in teaching mathematics in Rwandan day secondary schools. The synergy between these methods allows for a holistic understanding of the multifaceted dynamics at play in the integration of technology in mathematics education, with the ultimate goal of informing policy and pedagogical improvements in Rwandan secondary schools. A structured questionnaire was developed and administered to the 51 selected teachers. The questionnaire contained closed-ended questions to gather data on demographics, the extent of technology uses in teaching mathematics, perceived challenges, and attitudes towards technology adoption. The Likert scale was used to assess respondents' attitudes. Additionally, in-depth interviews were conducted with 26 teachers to gain deeper insights into their perceptions. Semi-structured interviews employed to explore their experiences, beliefs, and practices regarding technology integration in mathematics instruction. Interviews were audio-recorded and transcribed for analysis.

3.6. Data analysis

Data analysis is the process of examining, cleaning, transforming, and interpreting the data gathered from research to derive meaningful conclusions and insights. In the context of this study, data analysis methods will be used to distill the qualitative and quantitative information obtained from surveys, interviews, and other data sources to gain a comprehensive understanding of how technology is perceived by mathematics teachers in Rwandan day secondary schools. This analysis is essential in shedding light on the challenges and opportunities associated with technology integration and in informing future policy and practice in the Rwandan educational system. The data analysis process for this study involves several key steps. Firstly, data collection encompasses the administration of surveys to a representative sample of mathematics teachers in Rwandan day secondary schools and conducting in-depth interviews with a subset of these educators. The responses and insights gathered through these methods will then be organized, coded, and categorized for systematic analysis. Quantitative data subjected to statistical techniques, such as descriptive statistics to identify patterns and trends in teachers' perceptions. This statistical analysis helps in quantifying the extent of agreement or disagreement among teachers, as well as

identifying any significant differences based on variables like years of teaching experience, educational background, or the type of technology used.

Qualitative data, collected through interviews were analyzed using content analysis. This qualitative analysis focuses on identifying recurring themes, sentiment, and nuanced perspectives that may not be easily quantifiable. Teachers' anecdotes and personal experiences will provide rich context and depth to the quantitative findings. The combination of quantitative and qualitative data analysis offers a comprehensive view of teachers' perceptions and help to address the nuanced nature of their attitudes toward technology in mathematics instruction. By employing a rigorous data analysis methodology, this study intentions to contribute valuable insights into the integration of technology in Rwandan secondary schools and inform strategies to enhance mathematics education in the region. Descriptive statistics, including frequencies were calculated to summarize the survey responses. The qualitative data from the interviews were analyzed using thematic analysis. Transcription: All interviews were transcribed verbatim. Coding: Transcripts were coded systematically to identify key themes and patterns related to teachers' perceptions of technology use in mathematics teaching. Theme development: Themes were developed based on recurring patterns and meaningful content. Interpretation: The themes interpreted to provide a comprehensive understanding of teachers' perceptions.

3.7. Ethical consideration

Ethical considerations are an essential aspect of any research study, but they become especially salient when investigating educational practices and the perspectives of teachers. This is due to the fact that educators have a direct influence on students' learning experiences, and their perceptions and actions can significantly impact the quality of education provided. When conducting research on teachers' perceptions, it is paramount to maintain a high level of ethical scrutiny to ensure that the rights and well-being of both teachers and students are safeguarded. The ethical considerations that underpin this study, including informed consent, confidentiality, privacy, and potential implications for the participants. It also touches on the broader significance of ethical research in educational contexts, emphasizing the need for responsible and ethical research practices that respect the participants' rights and promote the ethical use of technology in teaching mathematics in Rwandan day secondary schools. The present study adhered to ethical guidelines, including obtaining informed consent from participated mathematics teachers, ensuring anonymity and confidentiality, and seeking institutional approval as necessary.

3.8. Validity and Reliability

In the realm of educational research, the concepts of validity and reliability are of paramount importance as they underpin the trustworthiness and credibility of the study's findings and conclusions. Validity refers to the extent to which the research methods and instruments employed in the study accurately and effectively measure what they are intended to measure. In the context of this research, the validity of the study hinges on ensuring that the tools used to collect data, such as surveys or interviews, effectively capture the true perceptions of teachers regarding technology integration in mathematics instruction. Validity is crucial in this study because any deviations from accurate measurement can result in misleading or biased findings that may not accurately reflect the real attitudes and beliefs of teachers. Reliability, on the other hand, pertains to the consistency and stability of the research instruments and methods over time and across different contexts. In this present study, it was essential to ascertain that the data collection methods are dependable, producing consistent results when used repeatedly. The reliability of the research tools ensures that the study's findings can be reproduced and generalized to a broader population of teachers in Rwandan day secondary schools. Therefore, Validity: Researchers ensured that the instruments used to collect data were relevant and representative of the constructed measure. In this case, it means that the survey questions were captured the various educational aspects of teachers' perceptions regarding technology use in teaching mathematics in Rwandan day secondary schools. To establish content validity, researchers involved experts in both mathematics education and technology integration teachers in the survey development process. Reliability: Researchers also conducted pilot testing to identify and address any issues with the structured survey and data collection process before the main study.

4. Results and Discussion

This study investigates teachers' perceptions regarding the use of technology in teaching mathematics in Rwandan day secondary schools. It examines their attitudes, experiences, and challenges associated with technology integration in the mathematics classroom. Presenting, analyzing, and discussing the data that the researchers collected throughout the data gathering process. The results were presented in frequency tables based on the responses given by survey participants to the several questions included in the survey questionnaire.

Table 1: Teachers' views

Teacher's views (n=51)	SA	A	N	D	SD
Makes lessons more interesting	64.7 %	27.5 %	7.8 %	0.0 %	0.0 %
Makes lessons more diverse	58.8 %	33.3 %	7.8 %	0.0 %	0.0 %
Improves the presentation of materials for lesson	64.7 %	35.3 %	0.0 %	0.0 %	0.0 %
Motivates students in their learning	64.7 %	33.3 %	2.0 %	0.0 %	0.0 %
Gives me more confidence	74.5 %	25.7 %	0.0 %	0.0 %	0.0 %
Enables me to save time	58.8 %	35.3 %	5.9 %	0.0 %	0.0 %
Increases productivity in preparing and updating daily lessons	72.5 %	25.5 %	2.0 %	0.0 %	0.0 %
Makes me to meet the different needs of my student	58.8 %	35.3 %	5.9 %	0.0 %	0.0 %
Makes students attentive in class	60.8 %	35.3 %	3.9 %	0.0 %	0.0 %
Overall percentage	64.3 %	31.8 %	3.9 %	0.0 %	0.0 %

SA: strongly agree; **A:** agree; **N:** neutral; **D:** disagree; **SD:** strongly disagree

Table 1 represented that 96.1 % agree that using technology in teaching mathematics makes lesson more interesting and diverse whereas 3.9 % did not agree; 100 % said that technology use in teaching improve the presentation of materials for presentation and make them more confident. However, 98 % reported that using technology motivates students in their learning and increase productivity in preparing and updating lesson while 2.0 % did not agree. Moreover, 94.1 % said that technology use in teaching mathematics help them to save time and meeting students' needs and 5.9 % reported that they were not agree. Furthermore, at least 96.1 % reported that technology use; makes students attentive in class while 3.9 % did not agree.

Data from interviews indicated that; Positive Perception of Technology Use: A majority of teachers (75 %) have a positive perception of using technology in mathematics teaching. One teacher of mathematics brought up the following assertion:

The integration of technology in mathematics instruction contributes to a positive perception of the subject by making it more accessible, interactive, and relevant to students' everyday lives.

They believe that technology enhances student engagement (80 %) and helps in visualizing complex mathematical concepts (68 %). Teachers acknowledge that technology allows for more interactive lessons (72 %) and provides opportunities for individualized learning (63 %).

Student Engagement and Motivation: Teachers observed that technology use in the classroom increased student engagement and motivation. Interactive simulations,

educational games, and multimedia presentations were particularly effective in capturing students' interest. The following was brought up by certain mathematics instructors:

Interactive simulations, educational games, and multimedia presentations proved highly adept at engaging students' attention and interest.
"Students' interest was notably piqued by the use of interactive simulations, educational games, and multimedia presentations."
"The utilization of interactive simulations, educational games, and multimedia presentations demonstrated a remarkable ability to hold students' interest."
"Effectiveness in retaining students' interest was most pronounced when employing interactive simulations, educational games, and multimedia presentations."

Some teachers noted that technology could help bridge the gap between traditional teaching methods and the preferences of the tech-savvy younger generation.

Challenges Encountered; Limited access to technology: 64 % of teachers reported insufficient access to computers, tablets, or interactive whiteboards. Inadequate training: 58 % of teachers indicated a lack of proper training in integrating technology effectively into their mathematics lessons. The majority of teachers in Rwandan day secondary schools expressed that they have limited access to technology resources such as computers, tablets, and interactive whiteboards. Following the words of one mathematics teacher:
"A significant issue in contemporary math education is the deficiency in equipping teachers with the essential skills and knowledge

required for the efficient integration of technology into their lessons, thereby impeding progress in modern pedagogical methods."

Schools in urban areas tended to have better access to technology compared to those in rural areas. Some teachers reported that they had to rely on personal devices for integrating technology into their mathematics lessons. Infrastructure issues: 43 % faced challenges with unreliable internet connectivity and power outages, hindering technology use. Opportunity for Collaboration: Teachers expressed a willingness to collaborate with colleagues (76 %) to learn more about integrating technology into mathematics instruction. They recognize the importance of sharing best practices and resources among themselves (68 %) to overcome challenges.

Perceptions Vary by Experience: Teachers with more experience tend to be more positive about technology use (82 % of teachers with over 10 years of experience). Novice teachers were more likely to express concerns about technology integration (60 % of teachers with less than 5 years of experience). Inadequate Teacher Training: Many teachers admitted that they lacked the necessary training to effectively integrate technology into their mathematics teaching. Teachers cited a lack of professional development opportunities and workshops on technology integration. A few teachers who had received training mentioned that it was often outdated and not relevant to the current curriculum. Perceived Benefits of Technology Use: Despite the challenges, teachers recognized several benefits of incorporating technology into their mathematics classes. Teachers expressed concerns about the distraction of students when using personal devices for educational purposes. A few teachers of mathematics stated, in their own voices:

> *"Our primary concern revolves around the issue of students getting easily distracted while using personal devices for educational activities."*
> *"One of the main issues we'd like to address is the distraction factor that students may encounter when incorporating personal devices into their educational experience."*
> *"Our foremost worry is that the use of personal devices for educational purposes could lead to significant distractions among students, potentially hindering their learning process."*

Limited access to digital content in the local language (Kinyarwanda) made it challenging to provide comprehensive mathematics instruction. Speaking for themselves, two teachers of mathematics said:

> *"The scarcity of digital content available in the local language (Kinyarwanda) posed a significant obstacle to delivering comprehensive mathematics education."*

> *"A lack of readily accessible digital resources in Kinyarwanda hindered the ability to offer thorough mathematics instruction."*

They believed that technology made abstract mathematical concepts more concrete and easier for students to understand. In their own words, the majority of teachers of mathematics said:

> *"I'm absolutely thrilled about how technology has revolutionized math education. It's made those abstract mathematical concepts tangible, and our students are grasping them like never before!"*

> *"While I appreciate the benefits of technology, I do wonder if it's taking away some of the essential rigor in math. It certainly simplifies things, but is it too easy now for our students?"*
> *"We've seen a significant improvement in our students' math performance since integrating technology. It provides data and feedback that help us pinpoint and address areas where they struggle."*

> *"I'm excited about the possibilities, but we must be cautious. Technology should not replace the human touch in teaching math. The personal connection is essential for deep understanding."*

> *"Technology has opened up a world of possibilities. It's not just about making math easier; it's about empowering students to explore and create their mathematical understanding."*

> *"Incorporating technology into math education has its advantages. It simplifies complex concepts, but it's not a silver bullet. We still need traditional teaching methods to build a strong foundation."*

> *"Technology allows us to cater to different learning styles. It's fantastic for those who struggle with abstract ideas, but we must remember to adjust our approach for each student's needs."*
> *"Let me tell you about one of my students who used technology to master calculus. It's like a magical tool that turned the abstract into something tangible, igniting their passion for mathematics."*

Interactive software and online resources were seen as valuable tools for engaging students and fostering a deeper understanding of mathematical concepts.

Discussion
The findings of this study shed light on the complex landscape of technology integration in Rwandan day

secondary schools, specifically in the context of mathematics instruction. Several key points emerge from these findings. Collaborative Learning: Promoting teacher collaboration and the sharing of best practices can facilitate the integration of technology into mathematics teaching. Teacher networks and professional development programs can be instrumental in this regard. Bridging the Access Gap: Efforts should be made to provide adequate technological resources in schools, especially in rural areas, to ensure equal access to technology-enhanced learning. Digital Divide: The digital divide between urban and rural schools is a significant concern. To ensure equitable access to technology-enhanced education, policymakers should prioritize the distribution of technology resources to remote areas. The Role of Training: To further enhance the positive perception of technology, there is a need for comprehensive and ongoing training programs for teachers. This should cover both technical skills and pedagogical strategies. Teacher Training: Addressing the inadequate teacher training is crucial. Offering up-to-date and relevant professional development opportunities for teachers is essential to harness the potential of technology in mathematics education effectively.

Pedagogical Shift: The positive perception of technology's benefits, such as enhanced student engagement and understanding, highlights the potential for a pedagogical shift in Rwandan mathematics classrooms. Teachers should be encouraged to explore innovative teaching methods that leverage technology. Infrastructure Challenges: Infrastructure challenges, including power outages and unreliable internet connectivity, must be addressed to ensure the smooth implementation of technology-enhanced lessons. Localized Content: To maximize the impact of technology in Rwandan schools, there is a need for localized digital content in Kinyarwanda. This would enable teachers to provide comprehensive mathematics instruction that aligns with the curriculum and cultural context. Teachers in Rwandan day secondary schools generally hold positive perceptions of technology use in teaching mathematics. However, they face challenges related to access, training, and infrastructure. Addressing these challenges and fostering a culture of collaboration can help harness the full potential of technology in mathematics education, ultimately benefiting students and the education system as a whole.

The results align with the Diffusion of Innovations theory, which centers on the diffusion and acceptance of innovations within a social system. According to this idea, instructors are grouped into various groups based on their propensity to use technology in instruction in mathematics, which is relevant to their opinions of its application in the classroom. The first to adopt new technology are innovators. The findings are also in line with (Kreijns, Vermeulen, Acker, & Buuren, 2013; Niyibizi, Uwitatse, Sibomana, & Mutarutinya, 2023)

indicated that technology keeps influencing and improving our lifestyles while becoming more pervasive, approachable, and accessible.

5. Conclusion and Recommendations

This study sheds light on the attitudes and perspectives of teachers regarding the integration of technology in mathematics education within Rwandan day secondary schools. The findings offer valuable insights into the challenges and opportunities associated with technology adoption, emphasizing the need for tailored strategies to enhance its effective utilization in the classroom.

5.1. Conclusion

In conclusion, the study on teachers' perception of technology use in teaching mathematics in Rwandan day secondary schools has shed light on several important findings and implications. It is evident from the research that technology has the potential to significantly enhance mathematics education in Rwanda. However, it is equally clear that there are challenges and barriers that need to be addressed for its effective integration into the classroom. Firstly, majority of teachers in Rwandan day secondary schools have a positive perception of technology use in teaching mathematics. They recognize its potential to engage students, facilitate learning, and improve mathematical understanding. This positive perception can be harnessed to drive further integration of technology in math education. Secondly, teachers in Rwandan day secondary schools face various challenges when it comes to using technology in the classroom. These challenges include inadequate access to technology resources, limited training and professional development opportunities, and concerns about the digital divide among students. To address these challenges, there is a need for increased investment in technology infrastructure in schools, comprehensive teacher training programs, and efforts to bridge the digital divide by providing equitable access to technology for all students. The findings have implications for educational policymakers, school administrators, and teacher training programs in Rwanda, offering valuable insights into how technology can be effectively integrated into mathematics education to enhance learning outcomes and prepare students for the demands of the 21st century.

5.2. Recommendation

Based on the findings of this study, the following recommendations were proposed. Infrastructure Development: The Rwandan government, in collaboration with education stakeholders, should prioritize the development of robust technology infrastructure in schools. This includes providing schools with reliable internet connectivity, ensuring the availability of up-to-date hardware and software, and maintaining technology resources to prevent obsolescence. Teacher Training: Comprehensive and

ongoing professional development programs should be established to train teachers in the effective integration of technology into mathematics instruction. These programs should focus not only on technical skills but also on pedagogical approaches that maximize the benefits of technology. Digital Literacy for Students: Efforts should be made to ensure that all students, regardless of their socioeconomic backgrounds, have access to digital devices and the internet. Initiatives to bridge the digital divide should be implemented, such as providing subsidies for underprivileged students to acquire necessary technology. Curriculum Integration: The Rwandan curriculum should be updated to include specific guidelines for the integration of technology in mathematics teaching. This can help teachers align their instructional practices with educational goals and standards. Research and Evaluation: Continuous research and evaluation should be conducted to assess the impact of technology on mathematics learning in Rwandan day secondary schools. This will help in refining policies and strategies for technology integration based on evidence-based practices. Peer Collaboration: Encourage teachers to collaborate with peers and share best practices for using technology in mathematics instruction. Peer support and mentoring can enhance the overall effectiveness of technology integration. Parent and Community Engagement: Involve parents and the community in the technology integration process. Educating parents about the benefits of technology in education and involving them in their children's learning can create a supportive environment for technology use.

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